Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] What is claimed is:

1. A system for measuring a position of an object in flight relative to a reference location, the system comprising:

three or more illuminating sources, each disposed in a predefined position, the three or more illuminating sources together emitting a plurality of distinct polarized radio frequency signals to provide temporally synchronized, pulsed radio frequency signals that illuminate the object;

one or more sensors disposed on the object for receiving the plurality of distinct polarized radio frequency signals from each of the three or more illuminating sources in flight; and

a processor for measuring a time for the plurality of distinct polarized radio frequency signals to propagate from each of the three or more illuminating sources to the one or more sensors and to determine a position of the object relative to the three or more illuminating sources based on the measured times.

[c2] 2. The system of claim 1, wherein the receiver further

calculates the distance of the object from the a reference point located at a known position relative to the three or more illuminating sources by determining an intersection point of spheres having the illuminating sources as centers, and the travel distances as radii, and by setting the distance of the intersection point of the spheres as the distance traveled by the object in flight relative to the reference location.

[c3] 3. The system of claim 1, wherein the one or more sensors comprises three or more sensors each comprising a waveguide cavity, the processor measuring an angular orientation of the waveguide cavities relative to at least one of the three or more illuminating sources based on a level of the signal received at the waveguide cavities in flight.

[c4] 4. The system of claim 1, wherein the object comprises a munition.

[c5] 5. The system of claim 4, wherein the reference location comprises a gun emplacement for firing the munition.

[c6] 6. The system of claim 1, wherein the one or more sensors are embedded within the object.

[c7] 7. The system of claim 3, wherein each of the three or more sensors are disposed on a surface which is not

parallel to the other of the three or more sensors.

[c8] 8. A method for measuring a position of an object in flight relative to a reference location, the method comprising:
disposing three or more illuminating sources in predefined positions;
emitting a plurality of distinct polarized radio frequency signals from the three or more illuminating sources to provide temporally synchronized, pulsed radio frequency signals that illuminate the object;
disposing one or more sensors on the object for receiving the plurality of distinct polarized radio frequency signals from each of the three or more illuminating sources in flight;
measuring a time for the plurality of distinct polarized radio frequency signals to propagate from each of the three or more illuminating sources to the one or more sensors; and
determining a position of the object relative to the three or more illuminating sources based on the measured times.

[c9] 9. The method of claim 8, wherein the determining comprises calculating the distance of the object by determining an intersection point of spheres having the illuminating sources as centers, and the travel distances as radii,

and by setting the distance of the intersection point of the spheres to a reference location as the distance traveled by the object in flight relative to the reference location.

[c10] 10. The method of claim 8, wherein the one or more sensors comprises three or more waveguide cavities and the method further comprises:
measuring a level of the signal received at each of the waveguide cavities from any one of the three or more illuminating sources; and
determining an angular orientation of the object based on the measured levels of the signal received at the waveguide cavities in flight.

[c11] 11. The method of claim 8, wherein the object comprises a munition.

[c12] 12. The method of claim 11, wherein the reference location comprises a gun emplacement for firing the munition.

[c13] 13. The method of claim 8, wherein the one or more sensors are embedded within the object.

[c14] 14. The method of claim 10, wherein each of the three or more sensors are disposed on a surface which is not parallel to the other of the three or more sensors.

[c15] 15. A munition comprising:
a casing having a nose and tail;
two or more fins disposed on the tail; and
three or more sensors each disposed on at least one of the casing and the two or more fins, wherein the three or more sensors receive a plurality of distinct polarized radio frequency signals from one or more illuminating sources for determining at least one of a position and orientation of the object relative to a reference location.

[c16] 16. The munition of claim 15, wherein the three or more sensors are embedded in at least one of the casing and two or more fins.

[c17] 17. The munition of claim 16, wherein at least one of the two or more fins has a first of the two or more sensors embedded in a longitudinal surface and a second of the two or more sensors embedded in a radial surface.

[c18] 18. A system for measuring an orientation of an object in flight relative to a reference coordinate system, the system comprising:
an illuminating source disposed in a predefined position, the illuminating source emitting a distinct polarized radio frequency signal to illuminate the object;
three or more waveguide cavities disposed on the object

for receiving the distinct polarized radio frequency signal from the illuminating source in flight; and

a processor for measuring a level of signal received by each of the three or more the waveguide cavities from the illuminating source and to determine an orientation of the object relative to the illuminating source based on the levels of measured signals.

[c19] 19. The system of claim 18, wherein the object is a munition and the illuminating source is located at a gun emplacement for firing the munition.

[c20] 20. A method for measuring an orientation of an object in flight relative to a reference coordinate system, the method comprising:

disposing an illuminating source in a predefined position;

emitting a distinct polarized radio frequency signal from the illuminating source to illuminate the object;

disposing three or more waveguide cavities on the object for receiving the distinct polarized radio frequency signal from the illuminating source in flight;

measuring a level of signal received by each of the three or more waveguide cavities; and

determining an orientation of the object relative to the illuminating source based on the measured level of received signals.